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Glimpses of the New Network:
The Real Convergence Story

BY KEVIN WERBACH

INSIDE

GLIMPSES OF THE NEW NETWORK 1
Slouching Toward Convergence 2
Sacred cows
Across the great divide
Hybrid Services 5
Keen.com
SoundBite
Pagoo
Acallto
Box: AOL's convergence play
ENUM: The Addressing Debate 14
Box: A short course on addressing
Phone numbers for the Internet
Box: How ENUM works
A tangled web
Talking 'Bout a Revolution 20
Resources & Contact Information 21
Calendar of High-Tech Events 22

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EDventure's High-Tech Forum – November 7-9, 2001 in Berlin.

Hybrid services that combine voice and data are the tip of an important iceberg. Above the waterline, these services suggest how the Net will change the ways billions of people communicate. Below the surface, phone numbers and domain names are coming together, paving the way for the merger of the Net and the global telephone network.

Today's converged service providers rarely advertise themselves as such, which is wise. They promote features and functions rather than promise the imminent demise of the old telephone network. Yet they are hastening that demise by familiarizing users with the Internet as a voice communications platform, hiding its data-centric underpinnings. Constructing the converged network will be arduous, with cultural conflicts among both vendors and end-users causing as many difficulties as technology gaps will. Once the process has begun, though, it's difficult to imagine it stopping.

Building great structures takes time. The pyramids, the cathedrals of Europe, the US interstate highway system and the telephone networks industrialized nations take for granted all required decades to complete. For the most part, we don't think of the Internet as a huge public works project because it operates over wires and privately owned computers already present in our homes and offices. But it is.

We also don't fully appreciate that the Net is a work in progress, from the bottom of the protocol stack to the top. As part of its evolution, the Net is merging with other communications networks. Digital convergence means more than television sets and personal computers sharing features. Perhaps even more significant is the

{ *continued on page 2* }

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ongoing integration of the Net and the public switched telephone network (PSTN).

This convergence won't happen overnight. And it won't necessarily happen the way one might expect. Services may converge even before the underlying hardware does. As Keen.com ceo Karl Jacob (SEE PAGE 6) notes, "What most people think is convergence means taking the two boxes we had before and slamming them together." Rather, he says, "usually both separate boxes will still exist, they'll just work together better."

The molecular constituents of every human being are constantly in flux as we develop, so that by the time we die we carry few if any of the same atoms that were in our bodies at birth. Similarly, the component parts of the Net and the PSTN are gradually being swapped out with ever more parallel hardware and software. While attention has focused on bandwidth and on traffic migration to Internet protocol (IP) telephony, companies are developing converged applications that provide value to service providers and to end-users.

Startups such as Keen.com, Soundbite, Pagoo and Acallto seamlessly combine elements of the Web, email and telephony. They offer particular services such as broadcast messaging and phone-based expert advice, but they also show glimpses of the grander future of convergence. Meanwhile, the emerging ENUM protocol (SEE PAGE 14) promises to unify telephone and Internet addresses, removing what may be the last important barrier to widespread deployment of IP telephony and related new services. As Richard Shockey, co-chair of the working group that developed ENUM, declares, "Convergence is not *if* anymore – it's *when*."

Slouching Toward Convergence

The converged new network has many elements. Basic voice services are migrating over to IP (SEE RELEASE 1.0, MAY 1999). Voice portals and speech-recognition platforms are making Web-like interactive services available to anyone with a telephone (SEE RELEASE 1.0, MAY

2000). Wireless data connections that put Web content and email onto mobile phones, along with hybrid devices such as the Kyocera Smartphone and the Handspring VisorPhone, are taking the Internet experience and making it mobile.

For the most part, these developments involve taking services already available somewhere – either on the phone or on the Net – and moving them to a new environment. Yet in such transitions something always changes, and new possibilities emerge from the interaction of services and platforms.

One of the most significant legacies of services such as voice portals will be the open development environments that make creating phone applications as easy as building Websites (SEE VOXEO IN LAST MONTH'S ISSUE). The companies we discuss this month will eventually take advantage of such development mechanisms, though so far they have had to develop most of their offerings from scratch.

Sacred cows make the best hamburger

Say "convergence" and most people focus immediately on broadband. The vision of high-speed data networks that support everything from interactive television to enhanced telephony is compelling (SEE RELEASE 1.0, FEBRUARY 1999). That vision will become a reality . . . just not right away.

Bandwidth is important, but bandwidth isn't everything. In wireless, for example, all the anticipation has centered on third-generation (3G) services that promise multi-megabit speeds to mobile handsets. Yet performance in the lab hasn't translated to similar speeds in the field, especially at commercial scale. While 3G deployment keeps getting pushed back, other services that don't require substantial bandwidth have experienced rapid adoption. For example, more than 20 billion short message service (SMS) message are sent monthly in Europe, and NTT DoCoMo in Japan has acquired 20 million wireless data subscribers in less than two years. The collapse of broadband data carriers such as Northpoint, Rhythms NetConnections and Covad is further evidence that bandwidth alone may not support a sustainable business.

Conventional wisdom about convergence is difficult to follow in other ways. It's a truism in the communications and computing industries that users ultimately care about services, not underlying technology. Less appreciated is how difficult it can be to determine what services users will find valuable.

Compare direct broadcast satellite (DBS) dishes with digital video recorders (DVRs) such as Tivo. For most US subscribers, the primary appeal of DBS is greater channel capacity, which seems relatively weak when most cable systems already offer 60-100 channels. Yet 1.7 million DBS dishes were sold in the first 18 months of availability. DVRs offer exciting new features such as the ability to pause live programming, automatically record shows and recommend programs you will like. So far, though, only 350,000 DVRs have sold in 18 months.

Focusing on price alone in communications can be dangerous. More than two-thirds of US households pay monthly fees for cable even though the competition – over-the-air broadcast TV – is free. Similarly, lower prices alone aren't enough to convince people to take a chance on unproven IP telephony technologies, except at the edges of the market.

The key is to identify what users want to do (or are already doing), then use the telephone infrastructure to support those functions. Individuals love to communicate person-to-person, which is why email, instant messaging, mobile phones and wireless messaging have enjoyed such astounding growth. The phone is great for one-to-one communications, but poor for one-to-many or many-to-many. Keen.com and SoundBite (SEE PAGES 6, 8) hope to fill this gap. Both use proven telephony technologies but layer sophisticated Web-based control mechanisms on top.

Customer adoption patterns are also crucial. SoundBite ceo John McDonough admits that his company's service could have been built ten years ago, albeit with higher infrastructure and development costs. But users weren't ready then. "Probably the biggest challenge would have been that people had not yet adopted the concept of asynchronous communication," argues McDonough. "I remember implementing email at a company I worked at. A lot of people resisted it because they felt it was impersonal." Today email is a standard tool of business in the US and many other countries. That means other services can borrow email's now-familiar idiom and extend it in new directions.

Across the great divide

The Internet runs on communications networks. However, there is a yawning chasm between the technologists and strategists of the Internet world – the Netheads – and their telephone counterparts – the Bellheads.

Remarkably, the division persists, not just in philosophies but in knowledge. “If you go to a phone person and explain that a service won’t work because of NATs [network address translators] or PPPoE [point to point protocol over Ethernet], you get a blank look. And the same thing happens if you start talking to an Internet person about SCPs [service control points],” says Pagoo ceo Joc Jacquay (SEE PAGE 10), a veteran of MCI. (Both camps share an unfortunate fondness for inscrutable acronyms.)

Of course, the Netheads and Bellheads need each other . . . or at least they need each other’s mentality. The Internet must achieve phone-like reliability and ubiquity, while telecom must open itself up to the decentralized innovation and local programmability that has propelled the growth of the Net. These points, especially the first one, are taken as givens by technologists on both sides of the divide. Still, the process will be rocky. The conflict over the ENUM protocol for mapping phone numbers to Internet addresses is one example (SEE PAGE 14).

Hybrid Services

Convergence is advancing on many fronts. IP telephony service providers such as Dialpad, iBasis and Net2Phone, though they haven’t yet conquered the world, have shown they can sign up millions of users for free PC-to-phone services. Wholesale providers such as ITXC have driven substantial volumes of long-distance voice traffic onto packet-based networks. Voice portals and voice infrastructure providers are taking Web-like services and making them available over the phone. A variety of conferencing, customer service and messaging application vendors such as HearMe, Lipstream, Evoke and eFusion are giving Websites the ability to support real-time voice communications.

The companies we discuss below take this process a step further. They use the Web/telephony interface to support new kinds of applications, based on sophisticated call control software. In traditional telco terms, these companies are building Internet service control points (SCPs). The telephone system uses a separate signaling infrastructure, known as the SS7 network, to enhance performance and support additional services (SEE RELEASE 1.0, DECEMBER 1999). SCPs are the SS7 network’s equivalent of Web servers. They interface with the databases that store phone numbers and other information, allowing calls to be routed dynamically and enabling carriers and others to offer interactive features.

Over time, standards such as the session initiation protocol (SIP) will commoditize some elements of Web-based phone applications. (The writeup on Eric Sumner of DynamicSoft in last month's issue talks about SIP in greater detail.) However, there will still be room for companies to build unique applications on top of commodity platforms. Feature sets, performance and user interfaces will be decisive over the long run. At this early stage of convergence, companies such as the ones below are gaining valuable experience in the market.

Keen.com: a keen business idea mingling advice and the phone

Several online advice sites launched in 1999 and 2000 including Exp.com, Keen.com, Information Markets and InfoRocket. (DISCLOSURE: ESTHER DYSON IS AN INVESTOR IN INFORMATION MARKETS.) These services connect customers seeking answers to questions with experts who answer them.

The basic idea is simple. In the physical world, people pay experts for advice all the time. Digital networks are great tools for connecting people and eliminating inefficiencies in the flow of information. (The late Phil Salin recognized this before the emergence of the Web with his American Information Exchange. SEE RELEASE 1.0, DECEMBER 1991.) Search is one of the most popular activities on the Net, and some portion of those billions of searches are people looking for the complex answers only a human is able to provide.

KEEN.COM INFO

Headquarters: San Francisco, CA
Founded: 1999
Employees: 125
Funding: $109 million from Benchmark Capital, Integral Capital, Vulcan Ventures, eBay, Inktomi, Microsoft, Merrill Lynch, CNet and Deutsche Bank Alex Brown
URL: www.keen.com

Though some of the advice sites have enjoyed success, only Keen.com has experienced exponential growth in traffic and revenues. The company, 18 months after launch, has over 2.5 million members and was one of the top-20 consumer e-commerce sites in January based on number of transactions.

The kicker is that, unlike most consumer services on the Web, Keen.com's advice isn't free. Experts (called speakers) charge per-minute fees they set for their advice, and Keen takes a percentage of those revenues (30 percent for live answers and 50 percent for recorded messages), above a baseline 5 cents per minute to recoup the telephony costs. The average per-minute rate for advice has been going up and is now about $2. Keen generated over $5 million in revenues in its latest quarter, and expects to reach profitability early next year.

Keen's founder and ceo, Karl Jacob, started early Java software vendor Dimension X, which was acquired by Microsoft in 1997. He spent two years at Microsoft and then went to Benchmark Capital as an entrepreneur-in-residence, emerging later in 1999 with Keen.com.

The element that distinguishes Keen from its competitors is its use of the phone as a fundamental part of the service. Interested customers (Keen calls them seekers) come to the Keen Website where they can see a directory of experts, review their qualifications and user-generated ratings, or search for experts on a specific topic. When you find an expert and provide your phone number, Keen initiates an automated call to you to verify that you understand the charges and want to continue. It then calls the expert and joins the two calls together, initiating the conversation. Keen also offers its expert directory over the phone through a voice portal at 1-800-ASK-KEEN, allowing users to participate in the entire process without having access to a computer.

"The ability to get someone right now is a combination of the phone and the Web," explains Jacob. "The phone provides the ability to have a dialog with someone. The problem with the phone system is there's no way to tell if that person is going to be there when you call, and there's no way for the person on other end to charge a different fee based on the value of the information." Keen bridges this gap by using the Web as a front end to phone-based interactions.

Behind the scenes, Keen has its own proprietary telephony software. "We actually initiate a request off the telephony system and say we'd like to call these two parties and connect them," explains cto Mark Halstead. Keen uses traditional time-division multiplexing (TDM) telephony hardware, but it couples that with its own software. Says Halstead, "The equipment we use has been around for a while. But most companies just used it to implement calling cards. We've taken the use of this equipment far beyond that."

Though the basic connection function sounds simple, implementing it is complex. Speakers must be able to specify via the Web or phone when they are available to receive calls, with that information automatically reflected to seekers. The telephony platform is the basis of the service's user experience, offering prompts and collecting usage data that both speakers and seekers can use to manage their activities. When seekers exhaust the amount of money they have pre-authorized on their credit cards, Keen's system automatically interrupts a call and asks them if they wish to authorize additional charges.

Combining telephony and the Web offers several benefits for Keen. One is privacy. Though Keen's system monitors the length of a session and the parties involved, the company doesn't listen in on the call itself. Moreover, because all calls are initiated by Keen, neither party has the other's phone number. Many sites use the Web as an intermediary to support anonymous email conversations, but traditional phone-based interactions usually require you to give out your number.

Another benefit of a phone-based service is that it makes it easy to do usage-based billing. "On the phone people are used to paying per minute," notes Jacob. "It's not a big stretch to change from paying per minute to talk to your friends to paying more per minute to talk to a doctor or someone else." The immediacy of response the phone allows also makes people more willing to pay, Jacob says: "There are lots of places you can get information. The difference is that on Keen you can get it right now, immediately. Consumers' time is very valuable."

Halstead says Keen has evaluated voice over IP technology but so far doesn't see the benefits exceeding the risks in terms of reliability and service quality. Cost savings aren't enough, he says, since TDM hardware prices and long-distance calling rates have already come down substantially (partly in response to competition from voice over IP). Instead, what gets Halstead excited is the possibility of new features such as more robust notification and roaming options. "You really need to know whether the speakers on Keen are available. So having this notion of presence or device location would be very beneficial to us," he says.

Going forward, Keen hopes to attack bigger categories in the vast information-services market, much as eBay moved beyond its early identification with collectibles such as Beanie Babies and Pez dispensers. Phone sex and psychics have traditionally generated the bulk of pay-per-call phone-based service revenue, but Jacob says adult services represent less than five percent of Keen's business. He points to recent deals with companies such as doctors' referral services and the increasing number of high-value (>$25) calls on the service as evidence Keen is moving up the value chain.

SoundBite: email for the telephone

SoundBite's founders John McDonough, Gary Culliss and David Parker came from Direct Hit, a popularity-based search engine (SEE RELEASE 1.0, JANUARY 1999). After Ask Jeeves acquired Direct Hit in January 2000, the three agreed to stay on board for several months. The day after that period ended, they convened at McDonough's home to start developing the business plan for their next venture. Say McDonough:

"We were really excited about what was going on in the world of telephony and wireless. We spent a lot of time studying what was successful in the world of the Internet, and what you could bring over to the world of telephony."

They came up with a simple but powerful idea: combine the one-to-many capability of email with the reach and immediacy of the phone. A SoundBite is a recorded phone message that can be sent automatically to groups of recipients and that also supports interactive functions. As McDonough, now ceo of SoundBite, explains: "We saw the adoption of email, and viewed that as simply a way for people to send interactive messages to each other. When we looked at the world of telephony and voice we didn't see an analogous application, and saw a need for it."

SOUNDBITE INFO

Headquarters: Burlington, MA
Founded: June 2000
Employees: 40
Funding: $7 million from North Bridge Venture Partners and Mosaic Venture Partners
URL: www.soundbite.com

SoundBite launched in December with a free consumer service, supported by advertisements embedded in the messages. The consumer service helped prove the concept, but McDonough says SoundBite's primary focus is on the corporate service it began offering in February. "The messages people receive can be managed just like email – people can reply, they can save, they can do group distribution," explains McDonough. Users can create email-like address books to send messages to a group of friends, a workgroup or a soccer team. The recipient gets the ability to respond with a voice message of his or her own, or can hit a key to call the sender in realtime.

Why not just use email? First, not everyone has access to email, and an even smaller percentage have access all the time. Moreover, McDonough explains, "There's real power in voice. The ability to hear the managing partner in the firm you work with tell you something is a powerful concept as opposed to text. The other powerful element is the direct connection to a human being to take action immediately."

The phone is also experienced as a more immediate, high-priority, personal channel than email, explains McDonough: "Email is not as immediately read. You can't count on people reading it immediately as you can with a telephone call. Especially if you're communicating with people at home."

This obviously raises red flags about privacy and spam, but here SoundBite has a few advantages over email. First, it charges for messages, so companies face a real cost in sending millions of SoundBites indiscriminately, unlike bulk emails. Furthermore, phone-based outbound marketing is highly regulated in the US. Unsolicited automated commercial messages are illegal to recipients with whom the sender has no

pre-existing relationship, for example. SoundBite works with its customers to encourage responsible behavior, such as giving recipients the ability to automatically opt out of future messages.

SoundBite is initially finding traction with direct-marketing programs. For example, a large household-appliance vendor traditionally uses direct mail and telemarketing to schedule home visits with its customers, in order to upsell high-end vacuum cleaners and other products. By sending automated messages to 30,000 customers instead, SoundBite cut the acquisition cost of a sales visit from $25 to $18, and also cut in half the percentage of customers who cancelled scheduled visits because those who took the initiative to respond were more likely to be sincerely interested. McDonough says this one customer, now rolling out the service in additional offices, could generate over $1 million in annual revenue for SoundBite. Other customers, such as a large travel services provider, use SoundBite for internal business communications such as broadcasting special offers to partner travel agents.

SoundBite is now handling a million messages per month. For the corporate service it charges for each message delivered, typically in the range of 20 to 35 cents. In some cases, it has charged based on success rates. For a computer networking magazine, for example, SoundBite replaced the paper or telemarketing-based process of annual renewal information verification and lowered costs by 75 percent.

McDonough says SoundBite is working to make it easier to create messages and is also looking to sign on more partners such as carriers and other voice application providers. “We see an important part of our future working with others who have the brands and customer bases,” he notes. Concludes McDonough: “There’s real power in being able to create a message and get it out to people immediately. I don’t see us as in any way shape or form as replacing email, just as email didn’t make our telephone costs go down. It’s just another form of asynchronous communication. There are times when email and fax make sense or should be used, and there are times when the telephone and voice make sense.”

Pagoo: answering the call for IP telephony management software

Pagoo got its start with Call Catcher, a free Internet voicemail application developed by two French technologists, cto Sylvain Dufour and vp of engineering Patrice Khawam. Call Catcher, which now has more than 1 million users, lets people share the same phone line for Internet connections and voice calls, by routing incoming calls when the user is online to a voice or text messaging inbox.

From that foundation, Pagoo has built a full IP-based call-management platform. The company first introduced a virtual second line service, a hosted PC-to-phone IP telephony offering that also supports inbound calls from any telephone to a personalized Pagoo-issued phone number. "We originally thought there was a market in the US for a voice-over-broadband second phone-line residential and small business service," says ceo Joc Jacquay, who joined in late 1999 after serving as coo of ISP roaming service GRIC Communications and ceo of integrator MCI Systemhouse.

PAGOO INFO

Headquarters: Dublin, CA
Founded: 1997
Employees: 100
Funding: $37 million from 3i, meVC Draper Fisher Jurvetson Fund I, Hummer Winblad and Selby Venture Partners
URL: www.pagoo.com

As it turned out, though, few residential broadband providers found the voice market worth attacking, because of regulatory and market conditions that made it difficult to compete against incumbent local telephone companies. The collapse of many independent DSL providers (and potential channels for Pagoo's ASP service) such as Northpoint and Flashcom also hurt.

Fortunately for Pagoo, it found other opportunities for its technology. ISPs and broadband providers outside the US were still interested in offering voice services. "In greenfield opportunities, service providers are embracing voice over broadband. They don't have all the regulations ILECs have," Jacquay explains. Broadband hardware vendors such as Tut Systems (SEE RELEASE 1.0, DECEMBER 1998) are also looking for the ability to add voice capabilities and services to their boxes.

In effect, Pagoo has reinvented itself as a software vendor. "We're selling software that is focused on instantaneous provisioning, service operations and billing," says Jacquay. It licenses the software to service providers such as Tiscali, the second largest ISP in Europe, as well as hardware vendors and integrators looking to add voice features to data networking infrastructure.

"Unless you have an intelligent layer similar to an SS7 SCP, you can't offer a vast range of services," says Jacquay. Translating into non-wonk terms, that means it must be easy to provision lines and to set up and deploy new services such as call forwarding, voice mail and conference calling, straddling the PSTN, the Web, email and instant messaging as delivery mechanisms. Pagoo's platform supports standards such as SIP (SEE RELEASE 1.0, MARCH 2001) and Media Gateway Control Protocol.

Jacquay rattles off some of the services that Pagoo's platform could make possible. "What you want to be able to do is go to a Web page and say, 'I want phone service. I want voice mail. I want, via either WAP [wireless access protocol] or a Web page, to

tell the system where to forward my calls if I'm not there. I want to be notified by email about voice messages and vice versa. I want to see my emails via a Web page and see if the senders are online. And I want to do a 3-to-4-way conference call with my regular phone, over either the PSTN or IP'." And this is just the beginning he says, because IP-based call control mechanisms will allow virtually any Internet service to be combined with the phone.

Acallto: who's calling?

Allen Razdow, co-founder and cto of Acallto, sees his service as one of the first real convergence applications. "There's a lot of convergence infrastructure, and there are a few convergence applications that are basically price-based like Net2Phone," he explains. "The Web hasn't really enjoyed feature-rich applications that are going to drive minutes through the infrastructure." Prior to Acallto Razdow served as ceo of data-mining company Torrent and before that co-founded MathSoft. Co-founder and ceo Frank Reece was formerly president of View Tech, which provides telecommunications and videoconferencing solutions. The company's third co-founder and director is well-known Internet technologist Scott Bradner of Harvard University.

ACALLTO INFO
Headquarters: Boston, MA
Founded: March 2000
Employees: <10
Funding: $1 million from individuals including Ted Johnson (formerly of DEC) and Brent Bilger (formerly of Cisco)
URL: www.acall.to or www.acallto.com

Acallto's initial concept was to use Web pages and URLs as substitutes for telephone numbers. When it initially launched last year, the company offered end-users personal URLs under the acall.to domain name. The idea was that instead of giving out a phone number you would give out your Acallto URL. People who wanted to contact you would go to the page and click a link to initiate a voice call (or fax or email message), allowing you to keep your phone number private and to determine which calls to take. The company's initial customer was the *Boston Phoenix* dating Website people2people.com, which used it to allow daters to talk on the phone without giving out their numbers.

It turned out that personal URLs weren't valuable enough to support a business. Explains Razdow, "What we realized is that click-to-call is just a technology. It needed to be embedded in a very feature-rich application that was targeted at particular situations and markets." As a result, the Acallto team revised its service, with the new version launching in February. Acallto now positions itself as an enabling service for Websites and companies that want to add PBX-like call-routing functions.

AOL'S CONVERGENCE PLAY

In addition to the startups and the technology vendors, there is another company taking aggressive steps in the convergence realm: AOL. Last year AOL acquired voice portal developer Quack.com (SEE RELEASE 1.0, MAY 2000) and used its technology to create AOL by Phone. The company also owns Moviefone, a popular phone-based automated movie ticket reservation system.

AOL's merger with Time-Warner, and its resulting entry into offline media and cable businesses, have received the lion's share of attention. But AOL's entry into the telephony realm also bears watching. For one thing, the company charges a monthly fee for AOL by Phone, showing that it's possible to generate revenue for such services. (Yahoo! announced this month it would start charging for its voice portal as well.) AOL's telephony push also illustrates where the IP and PSTN worlds overlap . . . and where they still don't.

"We saw the phone as the most ubiquitous device out there to access data," explains John Borthwick, vp of product development at AOL Interactive Properties. The immediate impetus for developing AOL by Phone, he admits, occurred when AOL vice-chairman Ted Leonsis was stuck in traffic for three hours during a trip to California, unable to get his email or to connect to the Web. The frustrated Leonsis directed his staff to look at what AOL features could be made available over the phone, using speech recognition as the primary interface.

AOL didn't know how users would react to the phone-based service, but it quickly discovered they saw it as an extension of the existing online service. "When they heard, 'Welcome! You've got mail,' on the phone, the experience of people was, 'Oh my God, I've just signed on to my AOL account'," says Borthwick. "They actually had a visual map of what they could navigate on the phone." The most popular features of AOL by Phone are communications – checking email and making phone calls – followed by content such as news and shopping, just as on AOL.

This doesn't mean the phone and the online service are the same. "When everything is just bits the temptation is to just shove it down all these different channels and to be indiscriminate about the interface," says Borthwick. "What we've learned is that you have to be very conscious of the form factor." The Moviefone team gives AOL a group with extensive experience building phone-based services, something the company is putting to use in developing interfaces. Moviefone also gives AOL a strong brand and local dial-in numbers (such as 777-FILM) in major cities around the US. By migrating Moviefone onto the same Quack-based platform as AOL by Phone, the company is both reducing its telephony costs and creating cross-promotional opportunities.

AOL isn't stopping there. "You'll see a broad swath of partnerships between folks like us and traditional telephony players. Our interest is to figure out how we can work with the regional Bell operating companies and the other telcos, because our business is not their business," Borthwick states. If there's any company that can pull this off, it's probably AOL. Phone companies have traditionally been reluctant to work with Web-based players because they fear losing their vaunted "control over the customer." But as both sides realize what they are and aren't good at, and as capital markets become more difficult for everyone, such partnerships may seem more appealing.

More and more people use the Web as the first point of contact for a company, even if they are looking for a phone number. If the site installs Acallto, such visitors can initiate a phone-to-phone call to people in the company with one click. Acallto users get a personal reception page they can configure to define what information shows up to whom, whether to accept anonymous calls and so forth. Visitors can sign up for a free Acallto ID, and if the recipient wants to accept the call from that caller, a link appears on the reception page that automatically initiates a phone connection between the two parties. "Essentially it has implemented an opt-in/opt-out relationship between the callers who are calling for free and the hosting Website that is paying for the calls and paying for the service," says Razdow.

Acallto hopes to convince companies they can make both their Websites and their PBXs more valuable by letting the one be the interface to the other. Acallto passes through the per-minute telephony costs to its customers with a small markup, and also charges an annual license of approximately $100 per seat for the service. The service also gives users the ability to establish public or private Web-based directories, and to review previous calls on the Web.

Acallto is now working with five pilot customers. In most cases, the value of the service is that it allows individuals associated with these companies to make themselves directly reachable over the phone, without giving out their number. For example, Planetwire.org intends to use Acallto for its worldwide network of experts who serve as resources on population and the environment for journalists. The *Standard-Times* of New Bedford, MA, wanted to list contact information for its reporters and other personnel without forcing them to take every call indiscriminately.

Acallto it now looking for additional financing to deliver and market its service more broadly. Today it is a small company, offering a solution for a particular niche opportunity, but it shows the kind of creativity that becomes possible when the phone and the Web come together.

(Un)comfortably ENUM: The Great Addressing Debate

If the Net and the telephone system are going to converge, their addressing structures must converge as well. An effort now underway called ENUM seeks to do exactly that. (The acronym doesn't stand for anything in particular.) The technical issues are straightforward, but the proposed standard raises some important policy and business questions.

Take a look at a typical business card. A decade ago you would expect to find nothing more than an address and a telephone number. Today fax numbers, mobile phones, pagers, email addresses and URLs are common, with the occasional ICQ instant messaging address. Things are getting cumbersome. Worse still, knowing any one of those addresses allows you to reach only a single device. If I have your office phone number I have no automated way to send you a voice message on your mobile phone or an email at the terminal in your hotel room.

A SHORT COURSE ON INTERNET AND TELEPHONE ADDRESSING

The two basic addressing structures of the Internet are IP numbers and the domain name system (DNS). IP numbers (e.g. 192.168.2.1) are what routers and other machines use behind the scenes to route traffic around the network; domain names are the alphanumeric addresses (e.g. edventure.com) that people use. Both have serious limitations in their current implementation, which are the source of contentious technical and policy battles.

The DNS grew out of an informal technical activity and suddenly became both a lucrative business and ground zero for battles about Internet governance and intellectual property law. There are a host of difficult questions: Who makes the rules? Should there be more generic top-level domains (gTLDs) like .com? What should they be? Who can assign addresses, and how? How to resolve trademark disputes or claims that "cybersquatters" have improperly registered names?

These and other issues are being tackled by the Internet Corporation for Assigned Names and Numbers (ICANN), a quasi-public global organization established in 1998 with the consent of the US Department of Commerce. (DISCLOSURE: Esther Dyson was the founding chairman of ICANN and now sits on its so-called At-Large Membership Advisory Committee.)

On the telephone side, addresses correspond to an ITU standard called E.164. Telephone numbers generally consist of a unique country code (e.g. 1 for the US, 44 for Britain, 978 for Israel), followed by a string of digits used to route calls within a country. Though every country doesn't use the same internal structure or even the same number of digits, this system ensures that every subscriber has a globally unique number.

Domain names and telephone numbers are both hierarchical. An address such as www.hotornot.com means the Web server underneath the domain name Hotornot, which is within the .com database. A telephone number such as 1 (202) 418-1000 breaks down into a country code (1 for the US), an area code (202) designating a local area (in this case Washington, DC), a block (418) signifying a particular telephone company and/or central office and a set of numbers (1000) for the particular subscriber (the office of FCC Chairman Michael Powell).

The two hierarchies are different, however. Phone numbers have traditionally corresponded to geography and network topology, meaning that a phone number actually specified the complete routing information to reach a destination. A domain name under a gTLD, by contrast, could be located anywhere in the world, on any ISP's network. From the beginning, therefore, the DNS has required database lookups for every query. With the introduction of competition in many countries, telephone numbers are also moving in this direction thanks to the need for local number portability. If I want to change from Verizon to Sprint as my local carrier but keep my number, the network must know to re-route the call.

Finally, until there is a migration path for the billion-plus legacy telephone numbers into IP telephony, the PSTN that Internet aficionados know and hate will not fade away. Users don't like changing their phone numbers. One Gallup survey found that 80 percent of customers would be unlikely to change local telephone companies if they had to switch numbers. And that's without taking a risk on a new technology such as voice over IP!

Addressing is essential to any network. If I want to send you an instant message or you want to download a file from my Website, our machines must be able to find one another. We take it for granted that we can call or exchange messages with anyone in the world if we know their telephone number or email address. Yet in the early days of the telephone network and the Internet such global address visibility did not exist. The willingness of network operators, online services and ISPs to make their email services interoperable was a major catalyst for the rapid growth of the

HOW ENUM WORKS

ENUM specifies how to turn a telephone number into a domain name. The number 1 (234) 567-8910, for example, becomes 0.1.98.7.6.5.4.3.2.1.e164.arpa. That looks like a mess, but it's important to point out that the translation happens automatically behind the scenes, and the newly-minted domain name is for internal network use rather than something end-users must remember.

The basic encoding mechanism of ENUM parallels the TPC.int Internet fax project that Carl Malamud and Marshall Rose set up in 1993. (SEE THE WRITEUP ON CARL MALAMUD IN RELEASE 1.0, MARCH 2000.) As Malamud and Rose realized, both domain names and phone numbers are hierarchical (SEE BOX, PAGE 15), though the hierarchy flows in opposite directions. The first digit in a phone number (the country code) is the most general, corresponding to the last element in a domain name (the TLD). So the way to map together the two systems is to reverse the order of a phone number and turn each digit into a separate sub-domain, then stick a special gTLD at the end.

When a domain name server encounters an ENUM address, it returns a special record called a naming authority pointer (NAPTR) that identifies the services available and the preferred mode of contact. A single ENUM-enabled telephone number could therefore enable a PSTN voice call, a SIP-based IP telephony call, an email communication, a fax or something else. In other words, an ENUM number could become a sort of universal address for a converged world. This is a powerful concept, but one that raises a host of privacy and security questions.

Internet in the early 1990s. And the success of the Web was due in part to the popularization of URLs, which for the first time made it possible to give every object (as opposed to just every machine) on the Internet a unique address.

IP addresses and domain names don't work well for occasionally-connected machines and people at the edge of the network, which is why emerging peer-to-peer applications such as instant messaging and Napster's file exchange service have created their own private address structures. (We discussed this topic more deeply in the writeup on PC Forum speaker Clay Shirky last month.) And IP is running out of addresses, a threat the proposed IPv6 standard may or may not solve, given the reluctance of ISPs and businesses to adopt it (SEE RELEASE 1.0, MAY 1999).

A variety of other potential standards battles are brewing. For example, for IP telephony, the Internet Engineering Task Force's (IETF's) SIP seems on the way to dethroning the International Telecommunications Union's (ITU's) H.323, a more heavyweight standard originally created for videoconferencing. But SIP, an edge-oriented protocol, may come into conflict with Megaco, a parallel IETF standard for communication between media gateways inside the network. SIP and Megaco were designed for different environments and can coexist. But it's also possible that carriers will emphasize Megaco because they want to control new services rather than allow them to be defined at end-user devices.

Phone numbers for the Internet

The most significant standards effort in this area is now picking up steam. Last September an IETF working group issued the proposed ENUM standard (RFC 2916) for encoding telephone numbers as Internet domain names. ENUM hasn't garnered much attention outside the technical community and the players already involved in the domain name wars. The details are indeed dry and complicated, but ENUM – and addressing more generally – is a significant element of convergence.

Virtually every mobile phone will soon have an Internet connection. If I want to dial a phone over the PSTN, I simply type the phone number. If I want to reach it over the Internet, though, I'm stuck. The phone may have an IP address (though it is most likely served through a NAT or other gateway), but even if it did I'm unlikely to know it. And typing a domain name or email address on a ten-key telephone keypad is not a pleasant experience – a particularly important issue for wireless data services. Moreover, what I really want most of the time is to find the *person* on the other end rather than the phone. I need to discover what communications services that person has available, and how he or she prefers to be reached in different circumstances.

Solving these problems was the motivation behind ENUM. In a nutshell, everyone agrees that having a way to link telephone numbers to Internet addresses is a good thing. There is little disagreement about the technical approach – mapping numbers into DNS addresses to piggyback the existing address resolution system as well as the existing universe of telephone numbers (SEE BOX, PAGE 16).

Joc Jacquay of Pagoo (SEE PAGE 10), which recently announced a partnership with NetNumber to implement ENUM services, summarizes the general viewpoint: "In the future, when I dial a phone number, there needs to be some database that does a lookup and decides how to route it. When you do that, you're getting the maximum efficiency of the global IP network." Or as IETF ENUM working group co-chair Richard Shockey predicts, "This could be one of the major kickoff points for global end-to-end voice over IP deployments."

A tangled web

Here things get dicey. Telephone numbering is overseen by government regulatory bodies such as the ITU and the US Federal Communications Commission (FCC), which often delegate management to contractors such as NeuStar (a Lockheed spin-off that serves as the North American Numbering Plan administrator). Domain

names fall under the purview of ICANN, which has agreements with VeriSign/ Network Solutions and the US Department of Commerce. Who makes the rules?

And these are only the threshold questions. Should geographic sub-domains (such as 4.4.e164.arpa for the UK) be managed by the government-designated numbering plan administrator for that region, the administrator of the UK country-code domain .uk, a different authority, or a central body that sets uniform policies for all ENUM addresses? What are the implications for Internet governance and the Internet's vaunted independence from government regulators? In the US, staff from both the Federal Communications Commission and the Department of Commerce (as well as the State Department) are engaged in the ENUM process, though what if any formal role either agency has remains uncertain.

Should there be one ENUM address root, E164.arpa, as advocated by the IETF, ITU and others? Or should multiple registries, including the E164.com service from NetNumber, be able to compete? (A group called the Internet Telephony Addressing Board (ITAB), chaired by IP telephony advocate Jeff Pulver proposed a .tel gTLD to ICANN as an alternative to E164.arpa, but its proposal was not accepted in the first round of new gTLDs ICANN authorized.) Does VeriSign (as the registry for .com) or NeuStar (which has been instrumental in developing the IETF's ENUM proposal and is also the ICANN-designated registry for .biz) have an unfair competitive advantage as potential ENUM registries?

For domain names there is no serious alternative to a single root database. Otherwise typing Amazon.com could give Al a bookstore and Ethel an educational site about a South American river. But it is possible to think of multiple companies offering top-level ENUM registry services, so long as there are mechanisms to prevent overlaps, because each telephone number already has a single authorized user.

Even if there is only one official ENUM root (the so-called "golden tree"), it may be overtaken in the marketplace by unregulated private competitors if implementation takes too long. Says NetNumber co-founder Doug Ranalli, "People will end up looking in the directory that adds the most value. All these questions about policy will be resolved as soon as you see momentum in registration at the ENUM end-points." NetNumber, which spun off from fax-over-IP provider Unify, is participating in the IETF/ITU process. At the same time, it's trying to convince application developers and convergence hardware vendors to embed its own proprietary ENUM resolution service.

The official ENUM process is moving extremely quickly for a standards effort involving governmental bodies such as the ITU, but that's still slow by the standards of most technology companies. Some thorny administrative questions remain. For example, how to manage the ENUM domain covering the US, since several agencies are involved and the country code "1" also includes Canada and the Caribbean.

Number of the beast

If you're familiar with the pitched battles over the domain name system during the past several years, this may sound like déjà vu all over again. And you'd be right. "Phone numbers are names. They're not really identifiers; they are names. We can't escape that," says Harvard's Scott Bradner, IETF transport area advisor to the ENUM working group (and co-founder of Acallto; SEE PAGE 12). Bradner sees no way around involving established phone companies and their regulatory bodies in the ENUM process, because it affects the management of telephone numbers.

Shockey, who works for NeuStar, agrees: "Once you're touching the telephony name-space you're touching the core of telephony itself. This, needless to say, activates the telecommunications companies as well as governments, the ITU and all sorts of other folks who may have been sitting on the sidelines of convergence." But this raises the possibility that traditional telcos will warp the ENUM process to slow down IP-based competitors. On the other hand, carriers such as WorldCom and Level 3 are aggressively deploying SIP networks, and even Bell operating companies such as Verizon are evaluating IP telephony for markets where they gain permission to offer long-distance service.

The golden goose in the golden tree

The reason companies such as NetNumber, NeuStar and VeriSign (which launched a ENUM testbed in conjunction with Telcordia in February) are taking such a keen interest in ENUM is that telephone numbers aren't automatically ENUM-enabled. Each number must be registered, much like a domain name, with the registrar charging a fee for provisioning and maintaining the record. Domain name registration is a big business, and there are about 30 million domain names in the Network Solutions database compared to more than 1 billion existing telephone numbers. In addition to registration, ENUM authentication services and software development promise to be lucrative. "This is going to be a very very big market," says Shockey.

The wider significance of ENUM, and of the specific implementation questions now being hashed out, really depends on your point of view. "It's a key point of convergence if you believe the world is phone numbers . . . which some people do," notes Bradner. E.164 phone numbers are the closest thing we have to a global identity infrastructure for the human race. However, other naming systems are growing rapidly, including email, AOL Instant Messenger, ICQ, Microsoft Passport and Napster.

The prospect of a universal IP-based addressing mechanism is both intriguing and scary. ENUM is confirmation of the Net's coming of age, but also a reminder of how far we have left to go in the grand project of convergence.

Talking 'Bout a Revolution

Predicting the future is a dangerous business. In hindsight it seems obvious why fax machines are ubiquitous today but flying cars are still science fiction, but of course that's the point.

There's also the small matter of timing. Ted Nelson had hypertext in the 1960s, Xerox PARC had graphical user interfaces in the 1970s and many startups had handheld pen-based computers in the early 1990s. All fundamentally sound ideas . . . all ahead of their time. And we can't forget Apple, perpetually just far enough ahead of the market to look prescient yet to miss the biggest share of the business opportunity.

COMING SOON

- Post-modern knowledge management.
- Broadband service platforms.
- Triumph of the Weblogs.
- Mapping the Net.

- And much more. . . (If you know of any good examples of the categories listed above, please let us know.)

Convergence has been the subject of enthusiastic predictions since digital technologies began creeping into the telephone network twenty years ago. It's instructive that the biggest surge of enthusiasm about high-speed multimedia networks occurred in the first half of the 1990s, just as the commercial Internet was taking off, but most predictions then assumed video-on-demand systems, rather than the unreliable bottom-up Internet, would be the vehicle for new converged services.

The oft-cited statistics showing the Internet with the fastest adoption curve of any major new technology are horribly misleading. First of all, they generally date the creation of the Internet from 1994, with the introduction of the commercial Web browser and the privatization of the Internet backbone. This obviously creates a

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steeper slope than an adoption curve beginning in 1969 with the creation of ARPANet, or 1973 with the launch of TCP/IP.

More subtly, the Internet is not one service, and the Internet of the mid-1990s is not the Internet of the coming decade. Signing up for phone service in 1970 was pretty similar to doing so in 1940, and not all that different from 1920. Prices were lower, service was more widespread and direct-dial long distance calling was available, but the basic feature set was similar.

With the rise of the new network, the Internet will still do all the things it does today. However, it will also become a primary channel for voice communications and for broadcast media (SEE RELEASE 1.0, NOVEMBER 1999). There's no way to predict with reliability what will be the killer app that will drive this transition, or how exactly users will view the Net differently. What can be said is that quirky, user-driven services and business offerings that offer simple and compelling benefits will enjoy success. The startups profiled above may or may not have found that winning formula, but they are on the right track in their approaches. ■ R 1.0

Calendar of High-Tech Events

2001

MAY 1-2	PERVASIVE COMPUTING 2001 - Gaithersburg, MD. Sponsored by the National Institute of Standards and Technology, this year's event will focus on applications. Contact Teresa Vicente at 1 (301) 975-3883; fax, 1(301) 948-2067; email, teresa.vicente@nist.gov; www.nist.gov/pc2001.
MAY 1-5	TENTH INTERNATIONAL WORLD WIDE WEB CONFERENCE - Hong Kong. Discuss the latest developments in web technology and the issues and challenges facing the web community as it moves into the 21st century. For more info, contact info@www10.org.hk; www.www10.org.
MAY 6-11	NETWORLD + INTEROP - Las Vegas, NV. Network with the networking community. For info, call 1 (650) 578-6900; fax, (650) 525-0224; www.key3media.com/interop/lasvegas2001.
MAY 16-19	CIO FORUM FINANCIAL SERVICES - New York, NY. Strategic IT forum for the US financial services industry. Presented by Richmond Events. Esther Dyson keynotes. Contact Conference Manager, Boukje van den Bosch-Smits at +44 (20) 8487-2248 or +44 (771) 055-0666; email, bvandenbosch@richmondevents.com; www.cioforum.com. E
MAY 21-24	GIGAWORLD IT FORUM - Las Vegas, NV. Giga Information Group's flagship event. Will address the technology and management challenges represented by the Internet. To register, call 1 (888) 577-4442; email, conferences@gigaweb.com; www.gigaweb.com.
MAY 22-25	VORTEX 2001 - Dana Point, CA. Bob Metcalfe and John Gallant once again pan for gold at the convergence of the Internet, telephone and television worlds. Call 1 (800) 633-4312; fax, 1 (650) 577-7840; email, registrar@idgexecforums.com; www.idgexecforums.com/vortex2001/about_2001.html.
MAY 30-JUNE 2	EMEDIATAINMENT WORLD - Los Angeles, CA. Entertain yourself at this conference focusing on traditional and digital media, advertising, emerging technologies and sports. Contact Kathryn Ullman at 1 (804) 727-6238; kullmamn@emarketworld.com; www.emediatainmentworld.com.
JUNE 9-12	EAST-WEST COLLABORATION CONFERENCE - Budapest, Hungary. To bring together companies and organizations from Central and Eastern Europe, the CIS and the 15 member states of the European Union with the purpose of helping them find potential business partners. Contact conference manager Viktoria Levai at +36 (1) 327-3100; fax, +36 (1) 327-3042; www.osi.hu/ep/im2001.
JUNE 11-13	SECURING THE INFOCOSM: SECURITY, PRIVACY AND RISK MANAGEMENT AFTER E-BUSINESS - Orlando, FL. It's a brave new world. For info, call 1 (203) 964-0096; fax, 1 (203) 324-7901; email, info@gartner.com; http://www.gartner.com.

Calendar of High-Tech Events

JUNE 12-14	EBUSINESS CONFERENCE & EXPO - San Jose, CA. There's no business like e-business! For more info, contact Ivan Resnikoff at 1 (415) 538-8946 or via email at iresniko@cmp.com; www.kingbird.com/ebusiness.
JUNE 19-21	INFOWORLD CTO FORUM - San Francisco, CA. Speakers include Dan Bricklin, Steve Jurvetson, Josh Levine, John McKinley and Ray Ozzie. For info, email ctoregister@infoworld.com; ctoforum.infoworld.com.
JUNE 20-22	STREAMING MEDIA WEST - Long Beach, CA. Experience the reality and boundless horizons of streaming technologies, content and business models. To register, 1 (888) 301-8890; email, register@streamingmedia.com; www.streamingmedia.com/west.
JUNE 24-27	MINDSHARE - Laguna Niguel, CA. Jupiter's executive forum. For more info, contact Katie Baker at 1 (212) 780-6060 x6103; fax, 1 (917) 534-6804; email, mindshare3@jup.com; www.jupiterevents.com/mindshare.
JUNE 25-26	14TH BLED ELECTRONIC COMMERCE CONFERENCE - Bled, Slovenia. This year's theme is e-Everything: e-Commerce, e-Government, e-Household, e-Democracy. For info, contact Joze Gricar at +386 (4) 237-4291; fax, +386 (4) 237-4365; email, gricar@uni-lj.si; ecom.fov.uni-mb.si.
JUNE 25-28	PC EXPO - New York, NY. In its 19th year, one of the largest IT events in the country. For more info, contact Meredith Zeitlin; call 1 (800) 249-8241; email mzeitlin@cmp.com; www.pcexpo.com.
JUNE 27-29	ECIS 2001 - Bled, Slovenia. The ninth annual European Conference on Information Systems will focus on global cooperation in the new millenium. Contact Joze Gricar at +386 (4) 237-4291; fax, +386 (4) 237-4365; email, gricar@uni-lj.si; ecis2001.fov.uni-mb.si.
JULY 22-25	INTERNET SUMMIT - Carlsbad, CA. The Industry Standard's flagship event. To register, call 1 (800) 255-1444; fax, 1 (415) 733-5401; email, conference-info@thestandard.com; www.thestandard.com/events. K
NOVEMBER 7-9	EDVENTURE'S HIGH-TECH FORUM - Berlin, Germany. Call Daphne Kis, 1 (212) 924-8800; fax, 1 (212) 924-0240; daphne@edventure.com; www.edventure.com. E K

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